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(56) Documents Cited
GB 2267789 A GB 2225908 A GB 2093647 A
EP 0353166 A2 EP 0349477 A2 US 5359657 A

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# (54) Overvoltage protection apparatus

(57) The protection apparatus 10 has voltage clamping circuitry for clamping voltage signals on a pair of telephone or communications lines TIP/A, RING/B at a predetermined potential, and current limiters 18, 20 in each line, the voltage clamping means including a pair of voltage clamping devices 12, 14 connected in series between the two lines and a third voltage clamping device 16 connected between ground and the junction of devices 12, 14. The predetermined voltage potential exceeds a primary AC power line peak value by a set tolerance value. Where the primary AC power line is 240 volts, each device 12, 14, 16 may have a breakdown voltage in the range 190 to 300 volts. Each device 12, 14, 16 may be a solid state bidirectional semiconductor transient suppressor device or a metal oxide varistor. The current limiters 18, 20 may be PTC resistors, or fusible resistors.

FIG.1

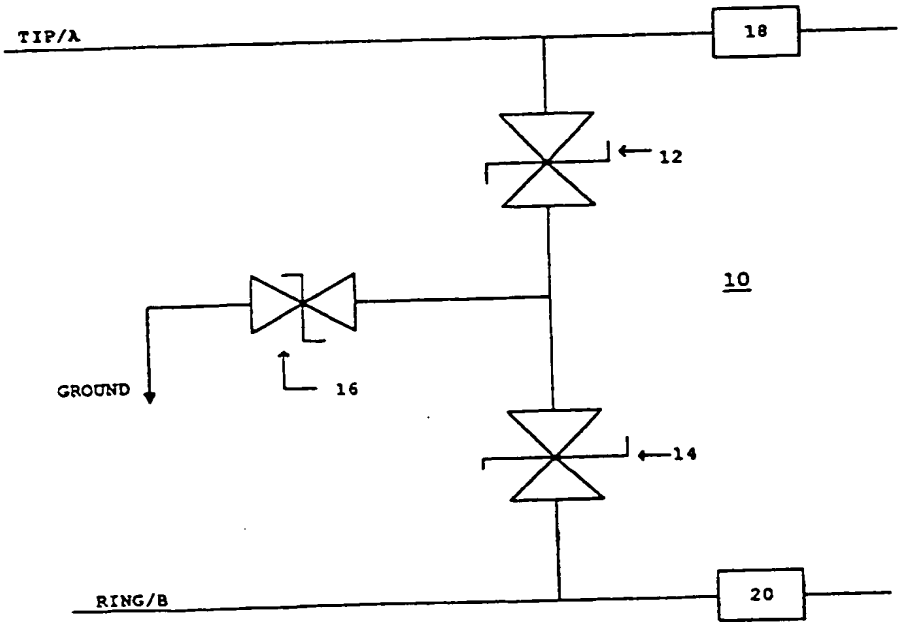


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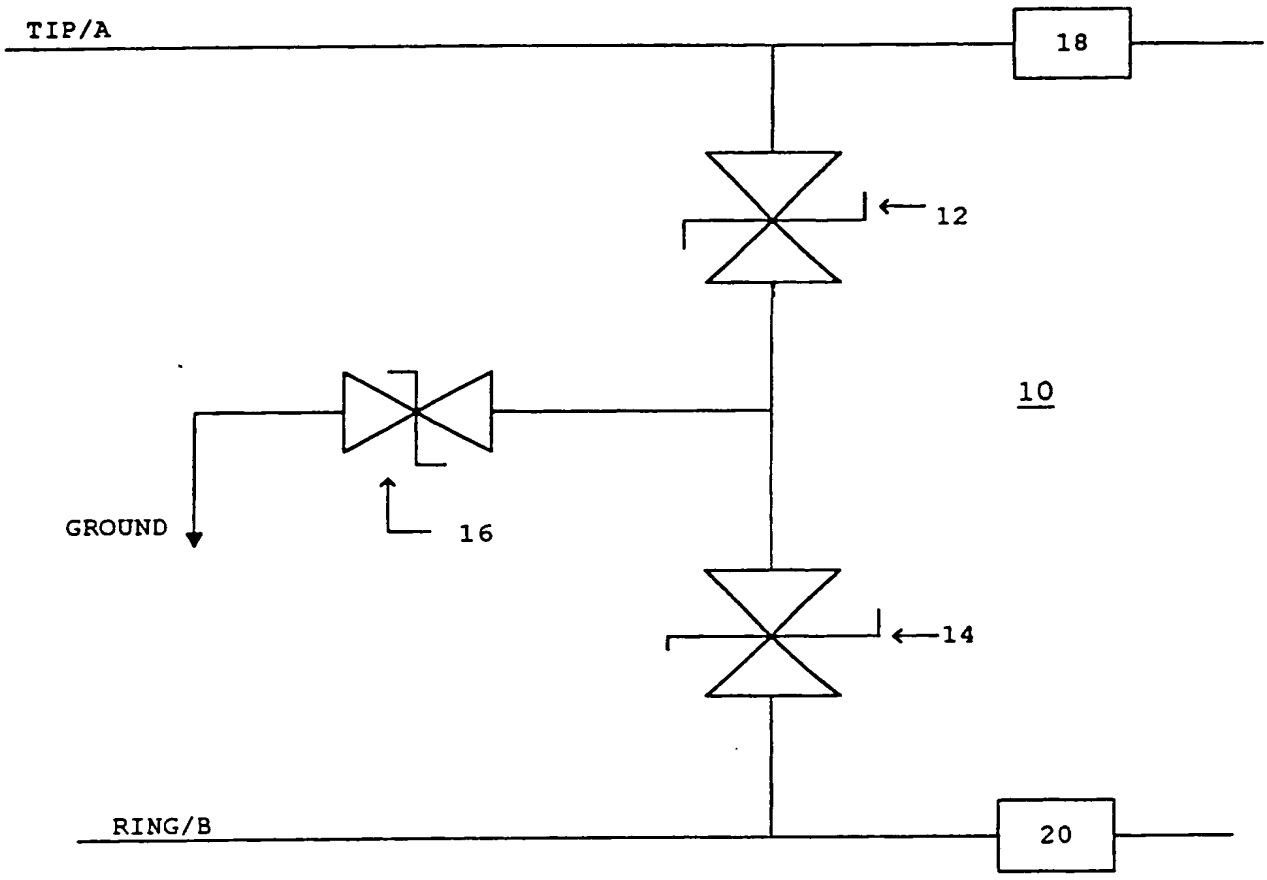
FIG.1



TITLE

Overvoltage protection apparatus

DESCRIPTION

The present invention relates generally to telephone line overvoltage protection devices, and more particularly to an improved telephone and communications line overvoltage protection apparatus.

Overvoltage protection devices are commonly used with telephone lines for protecting telephone equipment against hazardous voltages. Sources of transients include lightning, inductive switching electromagnetic interference (EMI), electrostatic discharge (ESD) and nuclear EMP (NEMP). Overvoltage protection circuitry that overcomes many disadvantages of the prior art circuitry is disclosed in Pelegris, United States Patent No. 5,357,568, issued October 18, 1994, Pelegris, United States Patent No. 5,359,657, issued October 25, 1994, McCartney, United States Patent No. 4,758,920, issued July 19, 1988 and McCartney et al., United States Patent No. 4,941,063, issued July 10, 1990 and assigned to the assignee of the present invention.

A disadvantage of some known overvoltage protection arrangements is that a safety hazard can result from the overvoltage protection arrangement during certain failure modes of operation. For example, one possible ground failure mode includes a disconnected ground connection for the overvoltage protection circuitry with a primary alternating current (AC) power line potential applied to the disconnected or ungrounded ground connection. With this failure mode, some known overvoltage protection circuitry provides an electrical conduction path for the primary power line potential to the TIP and RING lines. A need exists for an improved overvoltage protective apparatus which provides effective and fail-safe operation.

Among the principal objects of the present invention are to provide an improved telephone line overvoltage protection device and to provide a telephone line overvoltage protection device facilitating reliability and overcoming some disadvantages of known overvoltage protection devices.

In brief, the objects and advantages of the present invention are achieved an overvoltage protection apparatus. The overvoltage protection apparatus is used with a pair of telephone or communications TIP/A and RING/B lines including voltage clamping circuitry for clamping voltage signals on the lines at a predetermined voltage potential. The voltage clamping circuitry includes a pair of voltage clamping devices connected in series between the TIP/A and RING/B lines and a third voltage clamping device connected between a junction connection of the pair of the voltage clamping devices and a ground potential connection and current limiting devices for limiting current flow in the lines. The predetermined voltage potential exceeds a primary alternating current (AC) power line peak value by a set tolerance value.

The present invention together with the above and other objects and advantages may best be understood from the following detailed description of the embodiment of the invention illustrated in the drawing, wherein:

FIG. 1 is a schematic diagram representation of a telephone or communications line overvoltage protection device constructed in accordance with the present invention.

Referring now to the drawing, FIG. 1 illustrates an overvoltage protection apparatus designated as a whole by the reference character 10 and constructed in accordance with principles of the present invention. Overvoltage protection apparatus 10 includes a pair of solid state integrated circuit voltage clamping devices 12 and 14 connected in series between the telephone lines or communications lines labeled TIP/A and RING/B. A third solid state integrated circuit voltage clamping device 16 is connected between a ground potential and a junction connection of the voltage clamping devices 12 and 14. A pair of current limiting devices 18 and 20 are connected in series with the telephone or communications lines TIP/A and RING/B, as shown.

Each of the solid state integrated circuit voltage clamping devices 12, 14 and 16 is a bi-directional transient surge protector with a selected voltage clamping voltage for protecting from lightning, line transients and other high voltage spikes. In accordance with a feature of the invention, the combination of devices 12, 14 and 16 provide voltage clamping on the lines at a predetermined voltage potential that exceeds a primary alternating current (AC) power line peak value (Vt) by a set tolerance value (Voffset). Each of the devices 12, 14 and 16 advantageously have a selected voltage breakdown rating approximately represented by (Vt + Voffset)/2. Then each of the series combinations of devices 12 and 14, devices 12 and 16 and devices 14 and 16 equals approximately Vt + Voffset.

Various commercially available devices can be used for the solid state overvoltage devices 12, 14 and 16, for example, such as, a balanced, triple sidactor part number

P3403AB having a minimum breakover voltage rating of 300 volts and manufactured by Teccor Electronics, Inc. of Irving, Texas. Alternatively, transient voltage suppressers such as manufactured and sold by General Semiconductor Industries Inc., a Square D Company under a registered trademark TransZorb, or a metal oxide varistor (MOV) can be used for the voltage clamping devices 12, 14 and 16. A TransZorb device is preferred over a MOV for the voltage clamping devices 12, 14 and 16 due to its fail-safe or fails-shorted operation.

Each of the devices 12, 14 and 16 has a breakdown voltage and reverse standoff voltage without conduction selectively provided above the threshold value (Vt + Voffset)/2. For example, where the primary AC power line is 240 volts, a reverse standoff or breakdown voltage rating of (Vt + Voffset)/2 in a range between 190 volts and 300 volts can be selectively provided for the voltage clamping devices 12, 14 and 16.

Preferably the current limiting resistors 18 and 20 are positive temperature coefficient (PTC) resistors having a higher resistance value with higher current to provide a resettable fuse functional operation. Alternatively, resistors 14 and 16 are fusible resistors that open-circuit for current limiting at a predetermined temperature or corresponding current value.

While the invention has been described with reference to details of the illustrated embodiment, these details are not intended to limit the scope of the invention as defined in the appended claims.

## CLAIMS

What is claimed is:

1. An overvoltage protection apparatus used with a pair of telephone or communications TIP/A and RING/B lines comprising:

voltage clamping means for clamping voltage signals on said lines at a predetermined voltage potential; said voltage clamping means including a pair of voltage clamping devices connected in series between the TIP/A and RING/B lines and a third voltage clamping device connected between a junction connection of said pair of said voltage clamping devices and a ground potential connection; said predetermined voltage potential exceeding a primary alternating current (AC) power line peak value by a set tolerance value; and

current limiting means for limiting current flow in said lines.

2. An overvoltage protection apparatus as recited in claim 1 wherein each of said pair of said voltage clamping devices and said third voltage clamping device has a breakdown voltage without conduction selectively provided above a threshold value represented by (Vt + Voffset)/2, where Vt represents said primary alternating current (AC) power line peak value and Voffset represents said set tolerance value.

3. An overvoltage protection apparatus as recited in claim 1 wherein said series combination of said pair of voltage clamping devices and each combination of said pair of voltage clamping devices and said third voltage clamping device has a voltage clamping rating represented by Vt + Voffset, where Vt represents said primary alternating current (AC) power line peak value and Voffset represents said set tolerance value.

4. An overvoltage protection apparatus as recited in claim 1 wherein each of said pair of said voltage clamping devices and said third voltage clamping device has a breakdown voltage without conduction selectively provided in excess of one-half of said primary alternating current (AC) power line peak value.

5. An overvoltage protection apparatus as recited in claim 1 wherein said current limiting means are temperature responsive devices.

6. An overvoltage protection apparatus as recited in claim 5 wherein said temperature responsive current limiting means is a resistance fuse that open-circuits for current limiting.

7. An overvoltage protection apparatus as recited in claim 1 wherein each of said pair of said voltage clamping devices and said third voltage clamping device is a solid state device.

8. An overvoltage protection apparatus as recited in claim 1 wherein each of said pair of said voltage clamping devices and said third voltage clamping device is an integrated circuit device.

9. An overvoltage protection device as recited in claim 1 wherein each of said pair of said voltage clamping devices and said third voltage clamping device is a bi-directional semiconductor transient voltage suppressor device.

10. An overvoltage protection device as recited in claim 9 wherein each of said pair of said voltage clamping devices and said third voltage clamping device have substantially equal voltage breakdown values.

The Patent Office

**Application No:** GB 9521750.1
**Claims searched:** 1 to 10

**Examiner:** M J Billing
**Date of search:** 26 January 1996

# Patents Act 1977
# Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H2H HAPB, HAPC.

Int Cl (Ed.6): H01C 7/12; H02H 9/00, 9/04; H04M 1/74, 3/18, 5/16.

Other:

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| X | GB2267789A | (ONEAC) - Fig.1; page 4 lines 21 to 37 | 1 to 10 |
| X | GB2225908A | (TEXAS) - Fig.2; page 6 lines 15-20 | 1-4,7-10 at least |
| X | GB2093647A | (PHILIUPS) - Fig.8 | 1,5 at least |
| X | EP0353166A2 | (FLUKE) - Fig.2C | 1,5,6 at least |
| X | EP0349477A2 | (TECCOR) - Fig.2; column 4 lines 20-32 | 1,7-10 at least |
| X | US5359657 | (ONEAC) - Figs.1,14; column 3 lines 5-20 | 1-10 |

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|---|---|---|---|
| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
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